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Site Name Portage Cr. Kzoo River
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Michigan Department of Natural Resources
Surface Water Quality Division
November, 1983

A Survey of PCBs in the Kalamazoo River and Portage Creek Sediments, Kalamazoo to Lake Allegan, 1983

Polychlorinated biphenyl (PCB) contamination of the Kalamazoo River from the City of Kalamazoo to Lake Michigan (Figure 1) has been known for at least ten years (Hesse and Willson, 1972; Lauer, 1973). This contamination resulted primarily from previous industrial waste disposal practices. PCB contamination has caused the Michigan Department of Public Health to issue a fish consumption advisory for an 80 mile stretch of the river. The majority of PCB contamination in the river is suspected largerly to be in sediment depositional areas in five impoundments: Bryant Mill Pond (Portage Creek), Plainwell, Otsego and Trowbridge Impoundments and Lake Allegan. Presently, Bryant Mill Pond, Plainwell, Otsego and Trowbridge Impoundments are drawn down, leaving considerable areas of exposed shoreline sediments. Proposals have been made to re-impound the Plainwell, Otsego and Trowbridge impoundments.

This study was designed to give a preliminary assessment of the extent of sediment contamination at four of these sites and an estimate of the mass PCBs in each area.

Findings and Conclusions

1. Sediments were contaminated with PCBs at all four locations. In-stream sediment concentrations averaged 37 mg/kg in lower Bryant Mill Pond (Portage Creek), 25.6 mg/kg in the Plainwell Impoundment, 10.8 mg/kg in the Trowbridge Impoundment and 15.7 mg/kg in Lake Allegan.

2. Exposed shoreline sediments in the Plainwell, Trowbridge and lower Bryant Mill Pond were also contaminated with PCBs. Average PCB sediment concentrations were 22.6, 26.0, and 135.0 mg/kg, respectively.

3. The exposed sediments in the lower Bryant Mill Pond, Plainwell and Trowbridge impoundments appeared loosely consolidated and easily erodable. PCB contamination of apparently recent stream bank deposits in Portage Creek indicated the continued downstream transport of PCBs.

4. The estimated mass of PCBs in the four areas sampled plus the Otsego Impoundment was 227,910 lbs. Over half of this mass (132,000 pounds) was contained in the exposed sediments in the lower Bryant Mill Pond, Plainwell, Otsego, and Trowbridge Impoundments. The greatest in-stream mass of PCBs was found in Lake Allegan sediments, which contained approximately 75,000 pounds of PCBs.

Background

Prior to the late 1960's, direct discharge of paper manufacturing wastes to the Kalamazoo River was common practice. A major source of PCBs to the Kalamazoo River was a now defunct de-inking and recycling paper mill on Portage Creek, a tributary in the City of Kalamazoo. As a result, significant in-place sediment contamination exists behind the Plainwell, Otsego and Trowbridge and Lake Allegan dams. Much of the waste behind the Plainwell, Otsego and Trowbridge dams are dry because the impoundments were drawn down in the mid-1960's, leaving the sludge beds dewatered. Bhaskar et al (1983) sampled the instream sediments behind these three dams for PCBs in 1982. Miller (1983) conducted a preliminary evaluation of the dewatered sludge beds in the Otsego impoundment and found an average PCB concentration of 10.3 mg/kg dry weight PCB.

Horvath (1983) has shown that downstream transport of PCB contaminated sediments is occuring. PCB contamination of fish and the subsequent fish consumption advisory has resulted. Horvath (1983) also found that PCBs were being transported to Lake Michigan via water and suspended sediment from the Kalamazoo River.

Methods

Sediment samples were taken (Figures 2-5) by either 1) grab samples of the top few inches of sediment; 2) core samples using a clean plastic core liner; or 3) river channel grabs using an 18 inch long Ekman sampler. Samples were placed on ice and returned to the Environmental Laboratory in Lansing for PCB analysis.

In Lake Allegan, core samples were taken along three transects to estimate the average sediment PCB concentration. Core samples were 12 to 16 inches in depth with five to six cores per transect. The top four inches and bottom four inches of all cores within each transect were composited for analysis. In addition, three additional core samples were taken and the top and bottom 4 inches of each core analyzed as appropriate.

An estimate was made of the total mass of PCBs in the sediments at the following five impoundments: lower Bryant Mill Pond (Portage Creek), Plainwell, Otsego, Trowbridge and Lake Allegan. The first four are presently not impounded; therefore, estimates were made of both the PCB mass in sediments under water and those sediments previously inundated but now exposed due to impoundment drawdown. In calculating the PCB mass only 1983 sediment data were used. For the Otsego impoundment it was necessary to use Miller's (1983) data for the exposed sediments and Bhaskar et. al (1983) data for the in-stream sediments. The mean concentration was determined for each location. Mean sediment depth was estimated from on-site observations during sampling. The aerial extent was estimated from topographical maps and aerial photos of each location. Sediment density was estimated based on the sediment type observed and the associated density given in Garde and Raju (1977). For Lake Allegan and exposed sediments behind the other impoundments,

densities of 50 and 80 pounds/ft^3 dry weight were used. For river channels within the drawn-down impoundments, 100 pounds/ft^3 dry weight was used as a density. Harrison (1982) found a specific density of 79 pounds/ft^3 dry weight in one sample from Lake Allegan, indicating that the values assumed in this study are reasonable.

Results and Discussion

Detectable concentrations of PCBs were found in Portage Creek (Table 1) and the Plainwell (Table 2), Trowbridge (Table 3) and Lake Allegan (Table 4) sediments. The highest PCB concentrations were found in Portage Creek in the lower Bryant Mill Pond (Figure 2, Station 2). The average PCB instream-pond concentration in the Mill Pond channel was 37 mg/kg and ranged up to 105 mg/kg. Presently, the Mill Pond is not impounded and a large area of sediment was exposed. Exposed sediments near the stream channel were found to contain an average of 135 mg/kg with concentration up to 344 mg/kg PCBs. Lauer (1973) found concentrations in the Mill Pond ranging from 5 to 368 mg/kg PCBs. Much of the exposed sediments near the stream channel in this survey were barren, loosely consolidated and appeared highly erodable.

In Portage Creek downstream of Bryant Mill Pond at Stations 3 and 4, sediment PCB concentrations were 10 to 15 mg/kg. What appeared to be recently deposited sediments on the stream bank were also sampled and had similar PCB concentrations. This indicates that the downstream transport of PCB contaminated sediments is an on-going process.

Within the Plainwell Impoundment (Figure 3), the in-stream sediment PCB concentration was 25.6 mg/kg in an 18 inch core sample taken 50 feet upstream of the dam (Table 2). Sediment PCB concentrations in the exposed sediments behind the dam average 22.6 mg/kg with concentrations ranging from 0.6 to 55.9 mg/kg.

Within the Trowbridge impoundment (Figure 4), the in-stream sediment PCB concentration was 10.8 mg/kg within an 18 inch core sample taken 150 feet upstream of the dam (Table 3). Sediment PCB concentrations in the exposed sediment in the impoundment averaged 26 mg/kg and ranged from 3.8 to 73 mg/kg.

The average sediment PCB concentration in Lake Allegan (Figure 5) was 15.7 mg/kg based on the results from three transects (Table 4). Sediment PCB concentrations ranged from 5.1 to 28.3 mg/kg. Concentrations increased with depth in all core samples. The average concentration of the top four inches of sediment was 11.6 mg/kg while the bottom four inches of core samples averaged 19.8 mg/kg.

The estimated total amount of PCB in the sediments behind the five impoundments was 227,910 pounds (Table 5). Over one half of this amount (132,000 pounds) was contained in the exposed sediments in the lower Bryant Mill

Pond, Plainwell, Otsego and Trowbridge impoundments. Of these four sites, the Trowbridge impoundment contained the majority of the PCBs (89,500 pounds). The greatest instream mass of PCBs was found in Lake Allegan sediments, which contained an estimated 75,000 pounds of PCBs.

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Water Quality Surveillance Section
Surface Water Quality Division

References

Bhaskar, R., I. Brink, and B. VandeWege. 1983. Distribution of Polychlorinated Biphenyls and Dieldrin in Kalamazoo River sediments. Presented at the 87th meeting of the Michigan Academy of Science and Arts.

Garde, R. J. and K. Raju. 1977. Mechanics of sediment transportation and alluvial stream problems. John Willy and Sons. 483p.

Harrison, D. 1982. Polychlorinated biphenyls (PCBs) in fish, sediments and water in the Michigan Department of Public Halth fish consumption ban zone of the Kalamazoo River. Kalamazoo River Preservation Association. 11 p.

Hesse, J. and R. Willson. 1972. Evaluation of the aquatic environment of the Kalamazoo River watershed. MDNR.

Horvath, F. 1983. Organo-chlorine contaminants in fish, sediment and water in the lower Kalamazoo River and nearby Lake Michigan. MDNR. 35 p.

Lauer, J. 1973. Polychlorinated biphenyl survey of the Kalamazoo River and Portage Creek in the vicinity of the City of Kalamazoo, 1972. MDNR. 17 p.

Miller, T. J. 1983. Sediment samples from proposed Otsego hydroelectric reservoir. U.S. Fish and Wildlife Service, May 20, 1983 memo.

Figure 1. The Kalamazoo River from Kalamazoo downstream Lake Michigan.

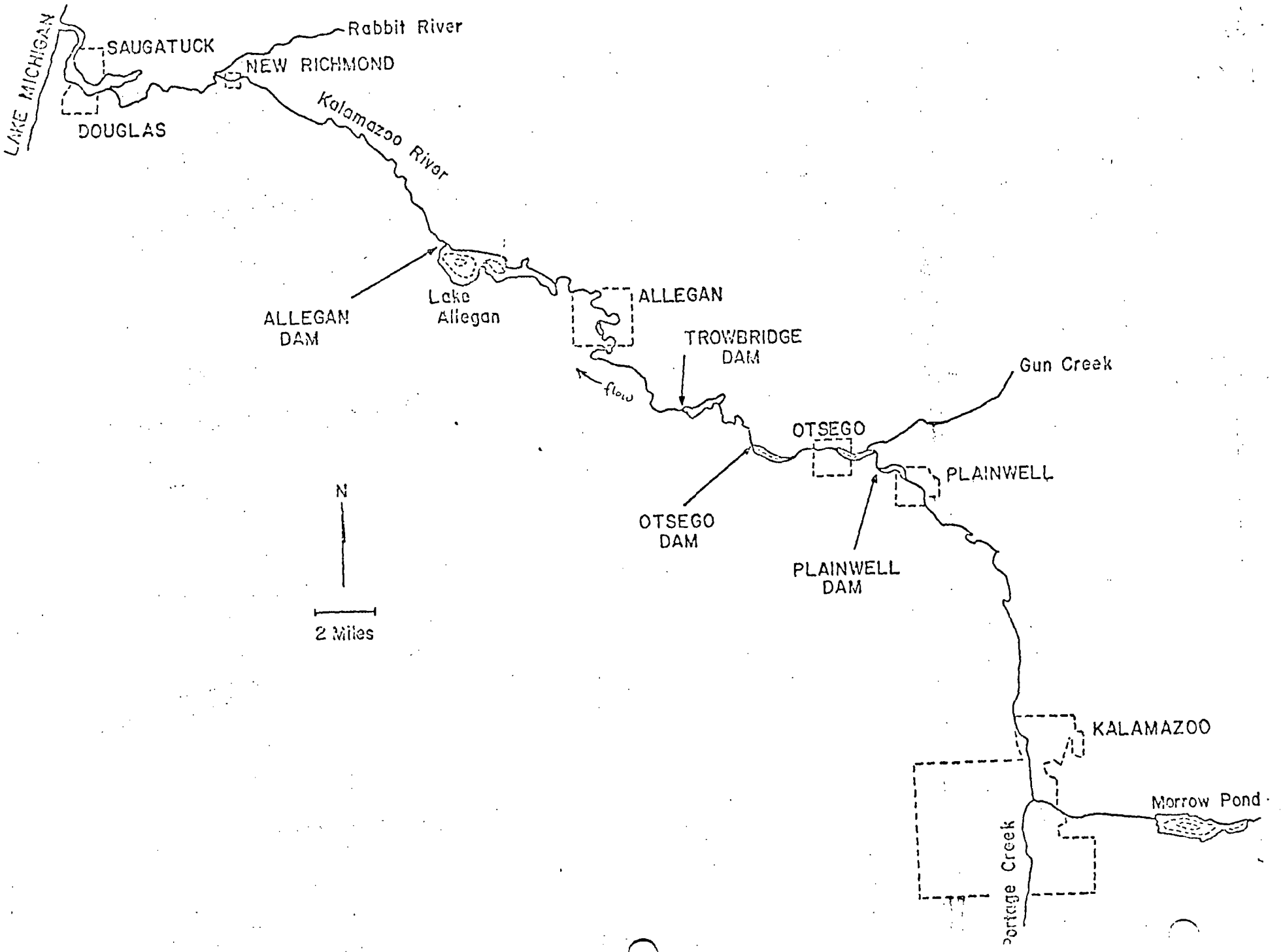

Figure 2. Sampling locations in Portage Creek, July, 1983.

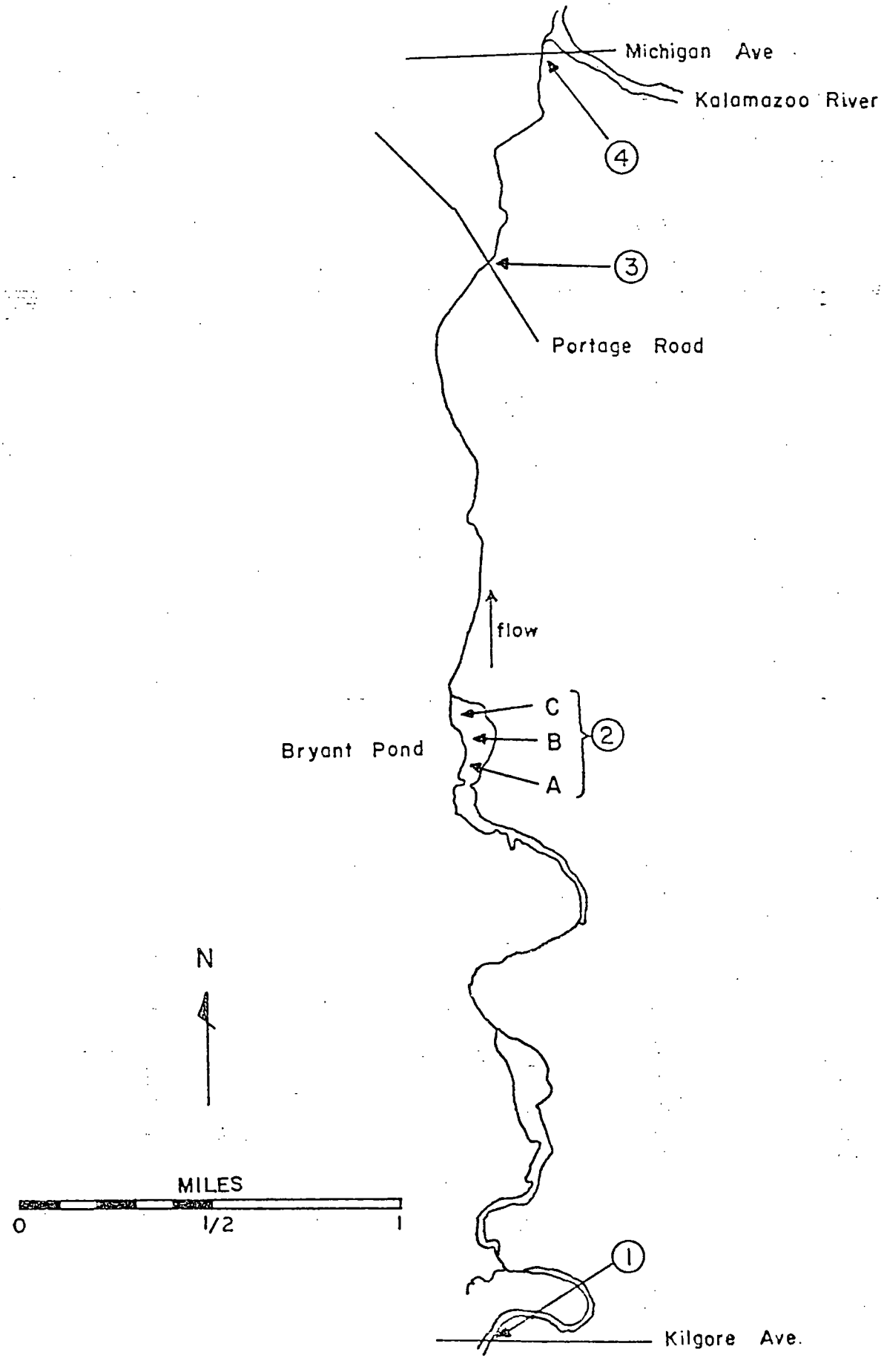

Figure 3. Sampling location in the Plainwell Impoundment, Kalamazoo River, June, 1983.

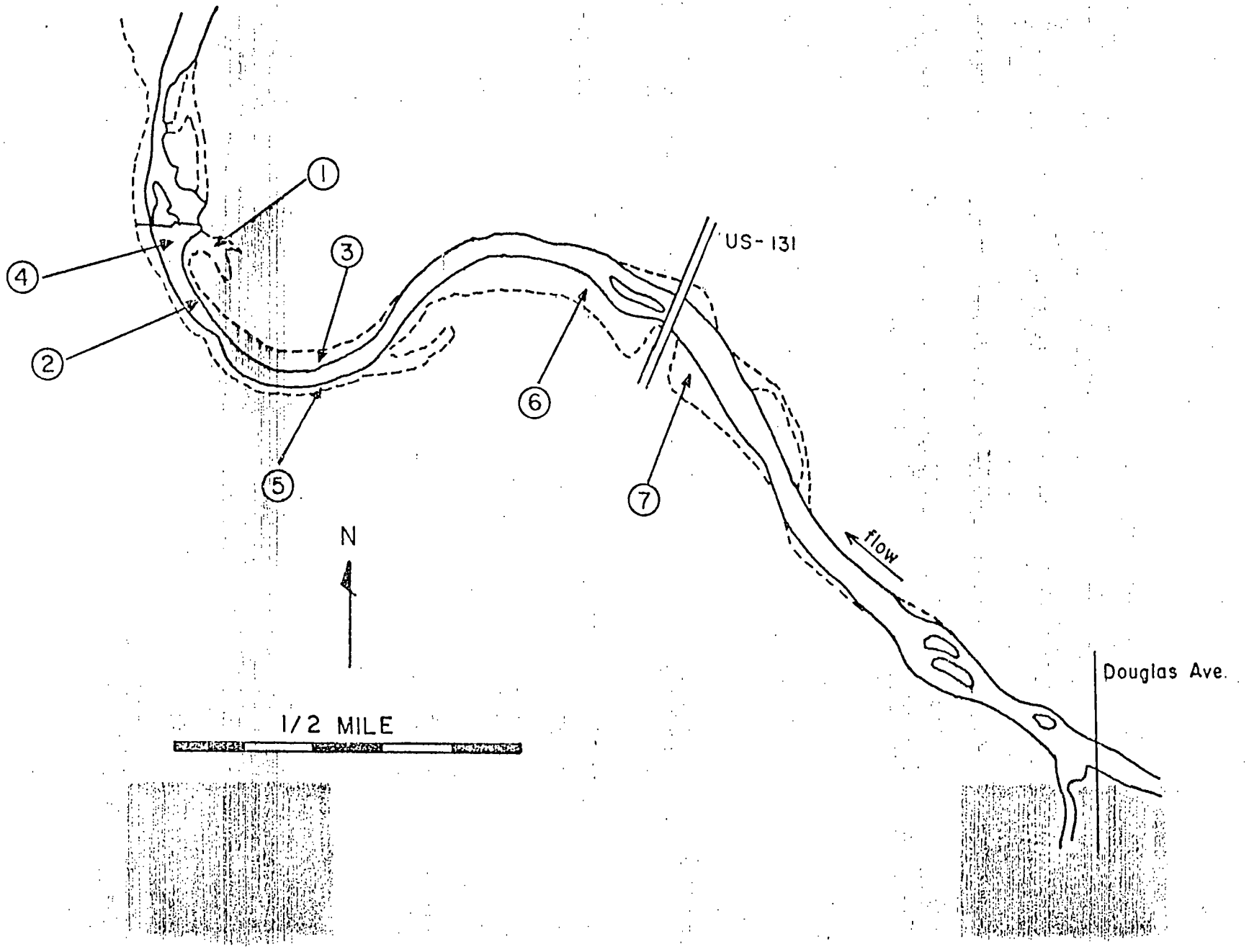

Figure 4. Sampling locations in the Trowbridge Impoundment, Kalamazoo River, June, 1983.

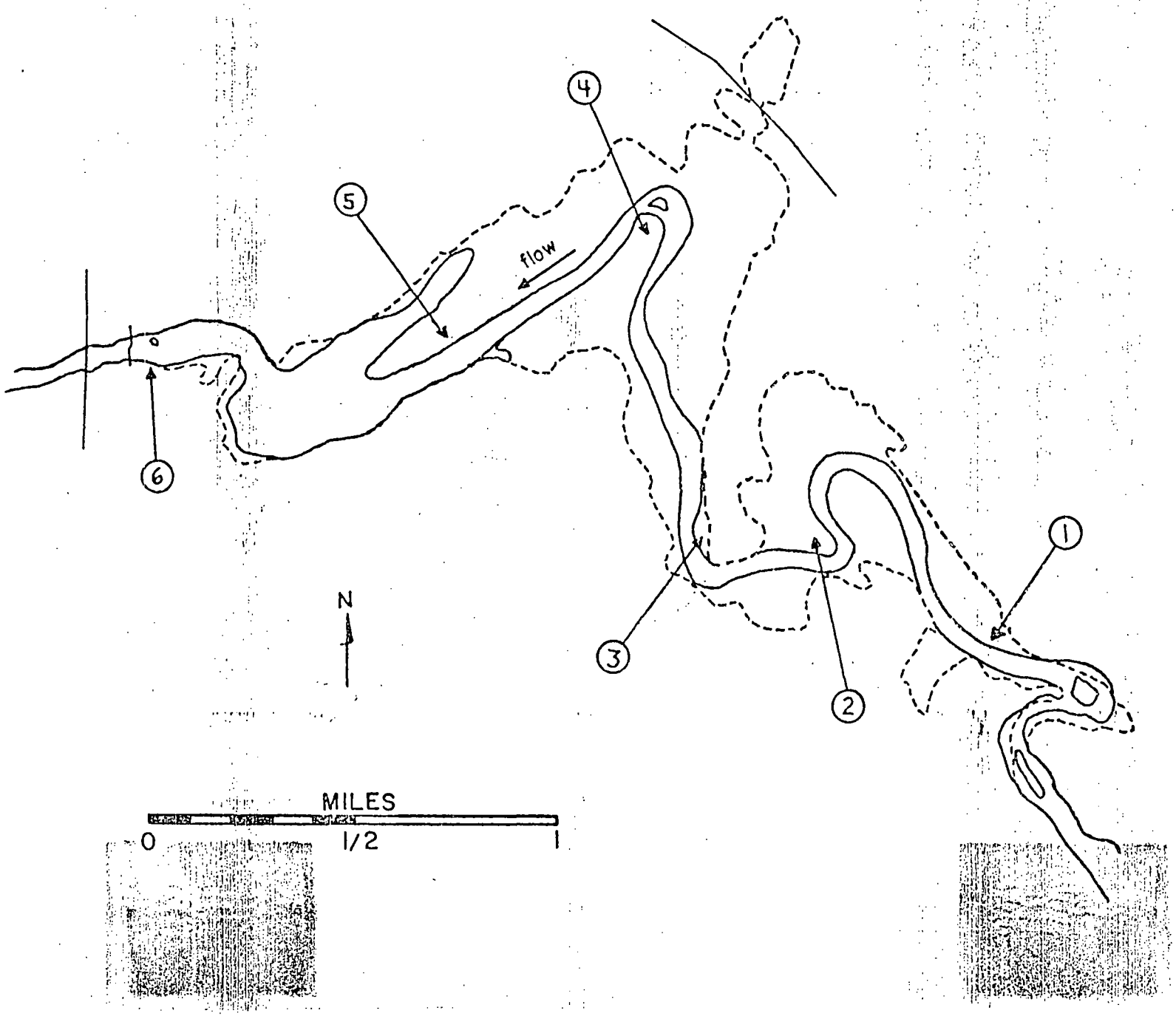

Figure 5. Sampling locations in Lake Allegan, July, 1983.

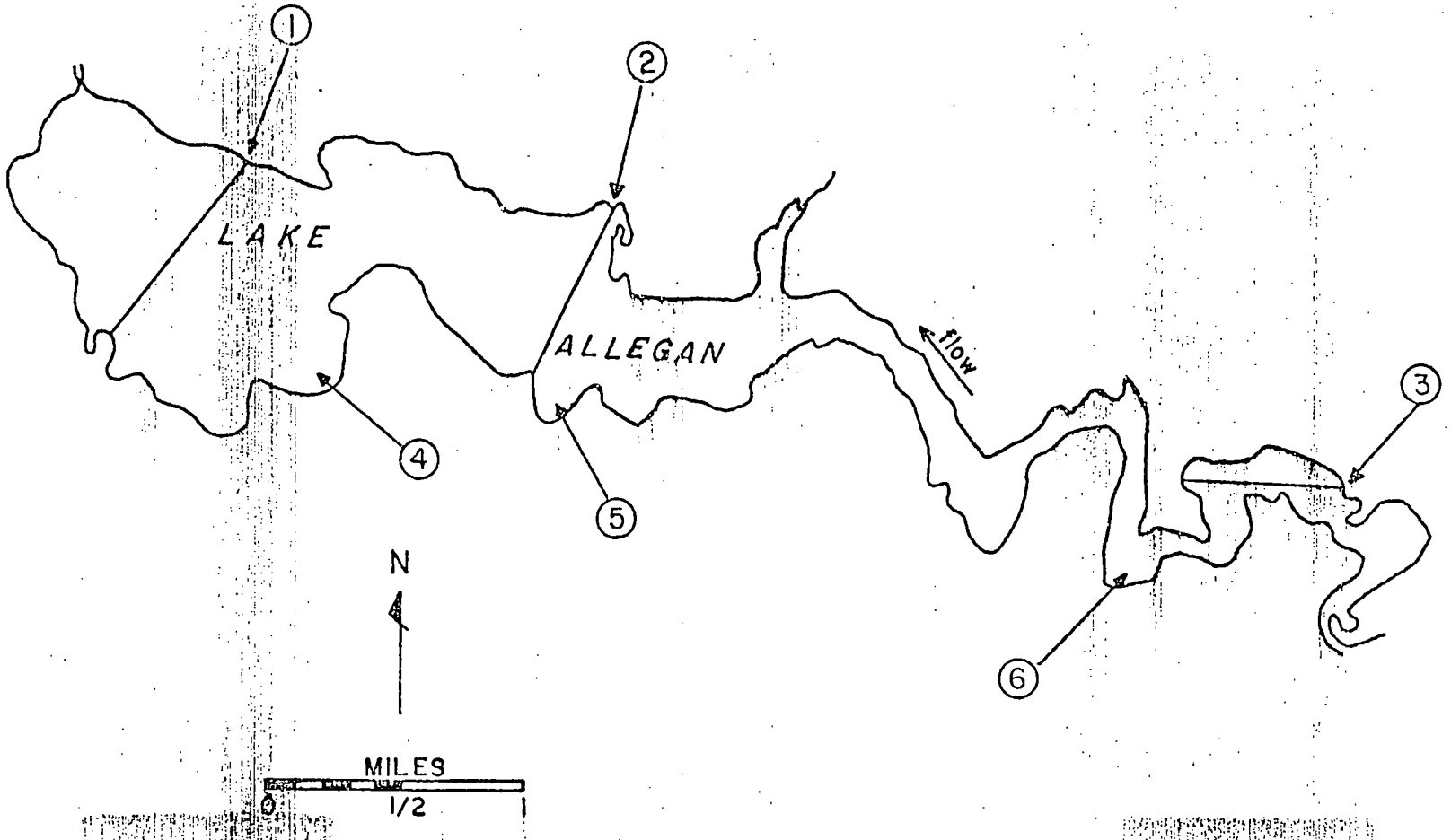

Table 1. PCB concentrations in Portage Creek sediments, Kalamazoo, July 22, 1983. Units are mg/kg dry weight.

Station	Location		Total PCB's	Total Solids (%)	Sediment Description
1	Kilgore Avenue		<0.100	62.0	Sandy silt
2	Bryant Mill Pond:				
	instream	(A)	3.3	40.6	Dark gray paper wastes, very oily.
		(B)	3.2	43.3	Gray-black sticky sediment, very oily.
		(C)	105.0	46.6	Gray, oily sediment.
	stream bank	(A)	23.0	33.9	Silty, no oils, likely to be eroded.
		(B)	344.0	56.3	Dried, crumbly gray paper wastes.
		(C)	36.9	28.9	Silty loose sediments, musty odor.
3	Portage Road				
	instream		10.0	44.0	Sandy silt, slight oils.
	stream bank		11.0	38.7	Loosely consolidated brown silt.
4	Michigan Avenue				
	instream		15.0	45.0	Silty, slight oils.
	stream bank		14.5	54.0	Silt, resembles paper wastes deposits

Table 2. Sediment sampling results from the Kalamazoo River, within the Plainwell Dam Reservoir, June 27, 1983.

Station	Location	Sample Type	Total Solids (%)	Total PCB (mg/kg dry wt.)
1	50' upstream of dam, south side of river	18" Eckman grab in river	41.3	25.6
2	100" upstream of dam, north side of river	10" core 2' above present river level	74.9	3.01 (top 4" of core)
			61.5	26.95 (bottom 4", $\bar{x}$ of 2 samples)
3	0.15 miles upstream of dam, north side of river	12" core 4" below present river level	45.8	55.9 (top 4" of core)
			38.0	29.2 (bottom 4")
4	0.3 miles upstream of dam, north side of river	10" core 2' above present river level	57.9	37.4 (composite)
5	0.3 miles upstream of dam, north side of river	grab near present river level	38.5	15.6 (top 1/4" of sediment)
			43.7	24.5 (sample without top 1/4")
6	0.75 miles upstream of dam, south side of river	10" core, 2' above present water level	44.2	25.0 (composite)
7	1 mile upstream of dam, upstream of 131 Bridge, south side of river	10" core, 2' above present water level	47.5	0.6 (top 4" of core)
			35.4	8.2 (bottom 4")

Table 3. Sediment sampling results from the Kalamazoo River, within the Trowbridge Dam Reservoir, June 27-28, 1983.

Station	Location	Sample Type	Total Solids (%)	Total PCB (mg/kg dry wt.)
1	Upstream portion of upstream reservoir basin, 3.2 miles upstream of dam	Grab, 4' above present river level	90.2	23.8
2	Middle portion of upstream reservoir basin, 2.5 miles upstream of dam	10" core, 1' above present river level	54.4 39.4	3.92 (top 4" of core) 8.9 (bottom 4")
3	Channel between reservoir basins, 2.2 miles upstream of dam	15" core, composited	50.7	44.2
4	Upstream portion of downstream basin, 1.4 miles upstream of dam	15" core, 3' above present river level 18" core at river's edge	46.3 45.6 49.0 43.0	3.8 (top 4" of core) 7.38 (bottom 4") 16.7 (top 4" of core) 50.9 (bottom 4")
5	Downstream portion of downstream reservoir basin, 1 mile upstrem of dam	Grab at present river level	40.0	$\bar{x}$ = 73.0 (64.9, 81.0)
6	South side of river channel 150' upstream of dam	18" Eckman, 3' below present river level	42.8 44.9	8.4 (top 2" of sample) 13.3 (bottom 2")

Table 4 Sediment sampling results from the Kalamazoo River, Lake Allegan, July 7, 1983.

Station	Location	Sample Type	Total Solids (%)	PCB (mg/kg dry wt.)
1	0.8 miles upstream of dam, transect across lake	16" cores	35.3	13.9 (bottom 4")
2	2 miles upstream of dam, transect across lake	16" cores	37.9 39.0	14.1 (top 4" of core) 25.2 (bottom 4")
3	Directly north of fa rgrounds, about 5 miles upstream of dam, transect across bend of river	12" cores	47.2 44.8	15.6 (top 4" of core) 20.2 (bottom 4")
4	1.25 miles upstream of dam, in bay on south side of lake	10" core	21.5	11.0 (top 4" of core)
5	2.1 miles upstream of dam, in bay on south side of lake	8" core	21.0 21.0	24.4 (top 4" of core) 41.7 (bottom 4")
6	Directly west of fairgrounds, in bay on south side of river, about 4.75 miles upstream of dam	12" core	33.6 27.7	17.8 (top 4" of core) 28.3 (bottom 4")

Table 5. Estimated PCB mass in pounds in the Kalamazoo River basin sediments at five impoundments.

Station	Location		Area (acres)	Estimated Sediment Depth (ft.)	Estimated conc. PCB (mg/kg dry wt.)	Estimated pounds of PCB
1	Portage Creek Lower Bryant Mill Pond	(Dry Sediment)	15	5	135	22,000-36,000
		(River Channel)	0.8	2	37	260
2	Plainwell Impoundment	(Dry Sediment)	50	3	22.6	7,000-12,000
		(River Channel)	50	1.5	25.6	8,000
3	Otsego Impoundment	(Dry Sediment)	50	3	10.3	3,000-5,000
		(River Channel)	50	1.5	0.5	1,650
4	Trowbridge Impoundment	(Dry Sediment)	407	3	26	69,000-110,000
		(River Channel)	157	1.5	10.8	11,000
5	Lake Allegan		1650	1	15.7	50,000-100,000
	Total Estimated PCB (lbs.) (Range)					227,910 (170,260-283,910)
	Exposed Sediments Only					132,000

Reference 8

Site Name Allied Paper-Portage Cr-Kzoo River

County Kalamazoo

CALL LOG

1) Verify Site Location and Size.
2) Verify # and size of each containment structure.
3) Is there existing exposure of people documented?
4) Is the site fenced? Is it secure?
5) If sampling was done, how were samples collected? i.e. random selective, surface grab, composite etc..
6) Has the fire marshall considered the site a fire hazard?
7) What type of companies used the site? (Origin of chemicals)

DATE	AGENCY	PHONE NUMBER	PERSON CONTACTED
11-9-88	MDPH	5 5305	Rich Bengel
		5 5320	Don Shinel

obtained the following information as to municipal well locations and populations served:

- Kalamazoo system has 45-50 wells located within 3 mi of River. The total pop. served is about 130,000 with approximately one-half being served by the wells located within 3 mi of River Station 20 is near Portage Creek south of Upjohn Playground.
- Parchment has 3 supply wells all are 55-60' deep. Total pop. served includes 200 homes in Cooper Twp - 2,617. Parchment has a contract to serve the area north in Cooper Twp. So far, about 200 homes in this area are now connected to the municipal supply.
- Plainwell [redacted] 4 wells serving a pop. of 4,502. Well #5 is [redacted] from the river and two of the wells are ≥ 40' from the river.
- Otsego has 3 wells serving 5,000 people. The wells are located ≥ 250' from the wetlands area along the river.
- Allegan has 4 wells serving 4500 people. Three of the wells are located adjacent to the treatment plant and are within 100' of the river.

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